IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: ***Jiang et al.***	)	Art Unit: **1795**
	)	
Application. No. **10/582,033**	)	Examiner: **Thorl Chea**
	)	
Filed: **August 21, 2007**	)	Confirmation No. **1674**
	)	
Title: ***Improved Lithographic Process***	)	Docket No. **22128-7192**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION UNDER 37 C.F.R. § 1.132

I, Dr. Kyle Jiang, based on personal knowledge or information and belief as indicated, hereby declare as follows:

1. I am an inventor of the invention(s) described in U.S. Patent Application No. 10/582,033, entitled "Improved Lithographic Process", which was filed August 21, 2007 (hereinafter referred to as the "Application").

2. I am a senior lecturer at the Centre for Biomedical and Micro/NanoTechnology in the School of Mechanical Engineering at The University of Birmingham, United Kingdom.

3. I performed operational tests of the claimed processes described in the Application (hereinafter referred to as the "Invention(s)"), wherein the claimed process (i.e., Invention(s)) is described at least as follows:

> A lithographic process for producing microstructures from an SU-8 photoresist, wherein the SU-8 photoresist has a thickness greater than 0.7 mm, comprising the steps of:

(i) exposing a prebaked SU-8 photoresist on a substrate to light at a total energy density in a range of about 18,000 to 35,000 mJ/cm^2, wherein the light comprises a combination of wavelengths including 436nm, 405nm, and 365nm, and wherein the exposing further comprises:

(a) exposing the SU-8 photoresist to the light without a filter;

(b) exposing the SU-8 photoresist to the light with a first filter that filters about 80% of the light at 365nm;

(c) exposing the SU-8 photoresist to the light with a second filter that filters about 90% of the light at 365nm; and

(d) exposing the SU-8 photoresist to the light with a third filter that filters all of the light at 365nm;

(ii) post-baking the SU-8 photoresist at a temperature of at least about 60°C; and

(iii) developing the SU-8 photoresist in a solvent,

whereby a microstructure is produced.

4. In addition to testing an embodiment of the Invention(s), I also performed tests of a control process believed to be the closest prior art that is commensurate in scope with the claims of the Application for purposes of comparing the Invention(s) to the prior art. The control process, including the testing parameters for carrying out the process (described below herein), was identical to that of an embodiment of the Invention(s) (described above in part 3 of this document), except that the exposing step was carried out in a single step, and no filtration of the 365nm light was conducted (hereinafter referred to as the "Prior Art Control Process"). (Please note that the description of the control process as a "Prior Art Control Process" is not intended to be an admission that such process is in fact prior art, but is instead is simply intended a comparison measure of the closest process known to me that does not include light filtering.)

5. The testing parameters used to conduct the tests were identical for both the embodiment of the Invention(s) and the Prior Art Control Process, except for the "exposure" step (as

recited above in part 4 of this document). Specifically, the testing parameters utilized were as follows:

(a) An SU-8-50 photoresist having a thickness of about 1 mm was used for each test. To fabricate the photoresist, about 12 ml of SU-8-50 photoresist material was cast onto a 10 cm square silicon wafer which was placed on a flat surface to allow the photoresist to spread evenly.

(b) The coated wafer was soft baked on a level hot plate for about 2 hours at a temperature of about 65°C, and then baked at a temperature of about 95°C for 30 hours. Subsequently, the heat was removed and the wafer was allowed to cool to room temperature.

(c) Exposure was carried out according to the manners described in the embodiment of the Invention(s), and in the Prior Art Control Process, respectively.

(d) The photoresist was baked at about 65°C for about 15 minutes and subsequently at about 95°C for about 25 minutes, and then allowed to cool to room temperature.

(e) The photoresist was placed in a bath of EC solvent which was magnetically stirred for about an hour. The solvent was then replaced with fresh solvent and the magnetic stirring continued for about another 15 minutes. The photoresist was rinsed with acetone, then ethanol, and then dried in a stream of nitrogen gas. The photoresist was then etched in a conventional manner to obtain microstructures.

6. The tests of the process described by the Invention(s) and the Prior Art Control Process were each performed numerous times under identical operating parameters to verify results, and the achieved results were consistent.

7. The tests of the process described by the Invention(s) produced high aspect ratio

microstructures, on the order of greater than 10:1, and in some experiments greater than 40:1. As was understood by those of ordinary skill in the art at the time the Application was filed, the term "aspect ratio" generally refers to the ratio of a shape or structure's longer dimension as compared to its shorter dimension. In the field of photoresists, microstructures, and lithographic processes, an "aspect ratio" is commonly understood to mean the depth (or vertical distance) of a microstructure by any of its lateral measures (e.g., width of the part or microstructure).

8. Microstructures with high aspect ratios are extremely important for use in a variety of applications, such as microengine components (as described in the Application).

9. The tests of the Prior Art Control Process did not produce high aspect ratio microstructures. Although the top grooves (i.e., grooves closest to the exposed photoresist surface) showed good definition, there was clear tapering and overall general non-linearity in the microstructures, beginning approximately 2/3 down the length of the microstructures (starting at the exposed photoresist surface) down to the base of the photoresist.

10. The microstructures produced via the Prior Art Control Process are poorly suited for use in microengine applications, as well as other applications.

11. As demonstrated by the results of the tests of the process of the Invention(s) and the Prior Art Control Process, the filtering of light at 365nm is critical to the ability to produce high aspect ratio microstructures from "thick" (i.e., thickness greater than 0.7 mm) photoresists.

12. Prior to testing the embodiment of the Invention(s), I had no expectation that filtering certain percentages of light at 365nm would produce high aspect ratio parts, as it is generally recommended by SU-8 suppliers to use 365nm as the optimum wavelength for exposure. Specifically, it was counterintuitive to filter out large percentages of light that were recommended and supposedly preferable for exposure of photoresists.

13. It is my belief that the results of the tests of the process described by the Invention(s) and the Prior Art Control Process, and as described herein, indicate a marked improvement in microstructures produced by lithographic processes as described by the claimed Invention(s).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements and the like may jeopardize the validity of the application and any patent issuing thereon.

Prof. Kyle Jiang

Date: 9th July 2010